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# Mortality in rural locations after severe injuries from motor vehicle crashes

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## Abstract

**Background—**Mortality from traffic crashes is often higher in rural regions, and this may be attributable to decreased survival probability after severe injury.

**Methods—**Data were obtained from the National Automotive Sampling System – General Estimates System (NASSGES) for 2002-2008. Using weighted survey logistic regression, three injury outcomes were analyzed: (a) Death overall, (b) Severe injury (incapacitating or fatal), and (c) Death, after severe injury. Models controlled for (pre-crash) person, event, and county level factors.

**Results—**The sample included 883,473 motorists. Applying weights, this represented a population of 98,411,993. Only 2% of the weighted sample sustained a severe injury, and 9% of these severely injured motorists died. The probability of death overall and the probability of severe injury increased with older age, safety belt nonuse, vehicle damage, high speed, and early morning crashes . Males were less likely to be severely injured, but more likely to die if severely injured. Motorists in southern states were more likely to have severe injuries, but not more likely to die if severely injured. Motorists who crashed in very rural counties were significantly more likely to die overall, and were more likely to die if severely injured.

**Conclusions—**Motorists with severe injury are more likely to die in rural areas, after controlling for person- and event-specific factors.

### Keywords

Mortality; injury severity; traffic; rural; NASS-GES

## INTRODUCTION

According to the National Highway Traffic Safety Administration (NHTSA), motor-vehicle crashes cause more than 40,000 deaths and 3 million injuries annually in the United States (NHTSA, 2008). Crashes present extreme challenges to Emergency Medical Services (EMS) systems, requiring immediate mobilization, effective management, and expeditious



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transport to an appropriate hospital. This current study examined whether EMS limitations in rural locations might affect the probability of death after being injured in a crash.

Several previous studies have established a strong association between rural location and the population-based incidence of motor-vehicle fatalities. Baker, Whitfield, and O'Neill (1987) found an inverse relationship between traffic mortality and population density, and theorized that “poorer access to trauma care” might contribute to the increased mortality in less populated areas. Rutledge, Fakhry, Meyer, Sheldon, and Baker (1993) found that counties with trauma centers had lower mortality attributable to injuries, but were criticized for failing to isolate factors that could be affected by trauma centers.

Goldstein and colleagues (2011) decomposed the variability in county deaths/population into deaths/injury, injuries/crash, crashes/exposure, and exposure/population. They found that most of the rural/urban variability was attributable to the increased risk of death among persons who have been injured. However, the authors recognized that an ecological study could not account for factors related to specific persons (e.g., age, seating position) or specific events (e.g., vehicle speed, time of day). In order to investigate how these factors jointly affect mortality, a national database was used that contained details about each crash and the individual motorists involved.

The principal objective of this study was to evaluate rural location as an independent predictor of adverse outcomes after controlling for person-level and event-level factors. The analysis included restricting models to only motorists with severe injuries. The current study examined the residual variability in outcomes among specific counties, and aimed to identify any county-level demographic or medical resource deficiencies that might be modified to improve injury outcomes.

# METHODS

National Automotive Sampling System - General Estimates System (NASS-GES) public-use data for 2002-2008 were downloaded from www.nhtsa.dot.gov. Because this study consisted of preexisting and de-identified data, an Institutional Review Board judged it exempt from review.

## Data Sources

NASS-GES (maintained by NHTSA) is a weighted stratified sample of police-reported traffic crashes resulting in personal injury or property damage (NHTSA, 2006). The 60 Primary Sampling Units (PSU), encompassing a single city or county or multiple counties, had been selected to represent 14 predetermined types of geographic areas (PSU Strata). Additional sub-sampling took place within each PSU, one for police jurisdictions, and another for crash types (Case Strata) based upon personal injury status and vehicle damage levels. The sampling weight assigned to each NASS-GES record is the product of the inverse selection probabilities at each sampling stage. The weighted analyses in this study accounted for the sampling design in order to obtain valid estimates and standard errors.

Creation of the study analytic file involved combining the crash (“accident”), vehicle, and person files using a derived identifier (ID) for each record. The unique ID consisted of the crash year, case number, vehicle number, and person number. The following variables collected by NASS-GES were investigated: Crash hour (midnight to 6 a.m. vs. other), adverse weather conditions (snow, rain, heavy fog), interstate highway, involvement of multiple vehicles, vehicle damage (moderate or severe), rollover, towed, high speed(> 50 MPH), person age (0-14, 15-39, 40-64, 65-79, 80+), gender, restraint use, seat position (front vs. other), ejected, hospitalization, and police-reported injury severity. For the majority of variables, missing values were replaced with imputed values provided by NASS-GES. In order to classify high-speed vehicles when the police estimate of speed was not available, speeding violation or posted speed limit at least 50 miles per hour were used as proxies (Clark, 2003).

NASS-GES data included only police assessments of injury severity (no injury, possible injury; non-incapacitating injury, incapacitating injury, fatal injury, injury of unknown severity, or died prior to crash). For this study, the term "severe" was used to denote injuries that were either "incapacitating" or "fatal." A few records indicating that the motorist died prior to the crash were excluded

Precise crash location was unknown. This study used a combination of resources to determine the county where the crash occurred. A NASS-GES Technical Note (NHTSA, 1991) listed only the PSU names (a city, or one or more counties) but no corresponding ID. For this study, each NASS-GES record with a driver residence ZIP code was linked to a corresponding Federal Information Processing Standard (FIPS) county code (U.S. Census, 2010). Within a given PSU ID in the analytic file, the following algorithm designated the crash county as: (a) the mode residence county if the mode matched to a single-county PSU (b) the drivers' residence county if that county matched to one listed in a multiple-county PSU and (c) the most populous county in the multiple-county PSU if the residence county did not match. This approach resulted in 77 crash counties, which were then linked to data about each county using the FIPS code.

A relevant subset of county characteristics was selected from the Area Resource File (HRSA, 2009) including Rural-Urban Continuum Codes (RUCC), population density, racial/ethnic groups, proportion in poverty, proportion without health insurance, and the number and characteristics of hospitals and medical personnel. The number of verified trauma centers for each county and presence of state trauma system characteristics was identified through an American College of Surgeons website (ACS, 2011) and a previous publication (Bass, Gainer, & Carlini, 1999) To be consistent with previous publications, the classification of "southern" states included those lying mostly below the 37$^{th}$ North Latitude (AL, AR, AZ, FL, GA, LA, MS, NC, NM, NV, OK, SC, TN, TX).

**Analysis—**To maintain a more homogeneous cohort for the main analysis, records were included only for motorists (i.e., occupants of a motor vehicle in transport) in cars or light trucks (<10,000 pounds gross vehicle weight). Figure 1 summarizes the inclusion and exclusion criteria. Further analyses were conducted using crashes for all vehicle types, or selecting only drivers, but are not reported in this paper as the results were generally similar.

Three outcome probabilities resulting from motor vehicle crashes were analyzed sequentially: (a) Overall probability of death; (b) Overall probability of sustaining a severe injury; and (c) Conditional probability of death among those with severe injury. This three-step modeling approach permitted separate analyses of factors associated with mortality overall and mortality restricted to motorists with severe injuries, since the latter would be most affected by the quality and rapidity of EMS systems.

Statistical tests and models were principally performed using Stata (Version 11, StataCorp, College Station TX). Weighted survey analysis was conducted using "svyset" choosing the appropriate variables for "cluster" (FIPS code or PSU ID) "weight" (NASS-GES weight) and "strata" (PSU strata). For two cases where the stratum levels contained one cluster, the "centered" option was used for adjusting standard error calculation. To compare characteristics across injury levels, the "svy: tabulate" command with a Wald Chi-Square was used. Logistic regression was performed using the "svy: logit" command. All results were verified using SAS (Version 9.1.3, SAS, Cary NC). In order to investigate a possible hierarchical structure for crashes within counties, models were also tested using HLM software (Version 6.08, SSI, Lincolnville IL). While the NASS-GES inverse probability weight was included, HLM 8.08 did not allow explicit survey design analysis aside from the weight.

## RESULTS

After exclusions were applied, the study analyzed 883,473 records from motorists involved in traffic crashes during 2002-2008 (Figure 1). This represented a weighted total of 98,411,993 motorists involved in crashes resulting in personal injury and/or property damage.

Table 1 provides the RUCC classification code definitions, along with the total number of NASS-GES counties and crashes for each code. Urban counties are overrepresented in NASS-GES, compared to US totals. However, NASS-GES contains a reasonably large number of crashes from rural counties (although none in RUCC Category 5).

Table 2 displays weighted percentages across four injury levels for certain crash characteristics about the motorist, vehicle, event, and location. Most motorists (83%) had no injury from the crash, even though there was vehicle damage. Only 15% had minor injuries, reported by police as “possible,” “non-incapacitating,” or “severity unknown;” only 2% had severe injuries, either incapacitating (n= 1,902,058) or fatal within 30 days (n=153,769).

Motorists 65 and older were significantly more likely to have severe injuries, and more likely to die. More than 66% of those who died were males. Higher percentages of fatal injuries occurred for belted and ejected motorists. Of motorists with an incapacitating injury, nearly all (95.8%) had been taken to a hospital for treatment. However, less than half (42.5%) of those who died were taken to a hospital, indicating that the majority died at the scene of the crash, although exact location and time of death are not in the NASSGES database. A disproportionate number of severe injuries involved vehicle rollover, high speed, alcohol, or early morning hours.

Table 3 shows the results of multivariate survey logistic regression for the three crash injury outcomes (odds of death, odds of severe injury, and odds of death given severe injury): When predicting the log-odds of crash death overall (Model 1), most of the associations from the descriptive analysis (Table 2) persisted after controlling for the effects of other variables. Older age groups, males, and unbelted occupants had significantly increased adjusted odds of death. Motorists in vehicles that rolled over, crashed at high speeds, or had serious damage had over a threefold increased likelihood of death, when compared to the absence of these risk factors. Crashes in the early morning (midnight to 6 a.m. were 1.6 times more likely to result in death than crashes during the day or evening. Motorists with crashes in a southern state or in a very rural county had a significantly increased probability of death.

Factors associated with severe injury (Model 2) were similar to those in Model 1, although odds ratios were generally lower in magnitude. One notable exception was that males were 23% less likely to suffer a severe injury compared to females. Front seat occupants were somewhat more likely to have severe injuries. The association of southern states with severe injury was stronger than the association with fatal injury alone (OR = 2.30 and OR = 1.79, respectively). Crashes in very rural counties showed increased odds of severe injury, while crashes in partially or moderately rural counties showed non-significant reduced odds of severe injury.

Model 3 predicted the odds of death, given that a person had suffered a severe injury from the crash, and was the outcome of greatest interest for EMS system evaluation. This model analyzed a subset of 84,639 motorists, compared to 883,473 in Models 1 and 2. As in the other models, older age strongly predicted mortality. However, in contrast to Model 2, males with severe injuries were 50% more likely to die than females. Mortality among those severely injured was increased for unbelted occupants, high speed, or rollovers. These variables could be considered as proxies for unmeasured injury severity (which NASS-GES does not quantify, other than the police classification). Compared to Model 2, the odds ratio of 0.82 for those with severe injury in southern states was lower, but non-significant. Severely injured motorists in very rural locations were almost twice as likely to die (OR = 1.93; 95%CI 1.64-2.27) compared to those in urban locations, even after adjusting for other person- and event-level factors.

This study evaluated the effect of many characteristics about each crash county (some listed in Table 2), however including these variables in the models did not add predictive value beyond southern and rural location. The results of Models 1, 2 and 3 were consistent when analyses included only drivers, or included medium and heavy trucks. Weighted multi-level models using HLM software showed similar trends and odds ratios of the same magnitude. Although, the variance component estimate for each model intercept was about half of standard deviation estimate, suggesting no advantage to having random intercept models.

## DISCUSSION

As classically described by Haddon (1972) the outcome of a traffic crash may be influenced by factors related to the host, the vehicle, or the environment, occurring before, during, or after the event. The associations of increased age, high speed, and lack of safety belts with serious injury or death have been described many times in the literature (Zlatoper, 1989). Prevention of crashes and protection of motorists have proven to be effective overall strategies to reduce mortality. However, the current study primarily focused on the post-event, environmental cell of Haddon's matrix, attempting to identify ways to minimize adverse outcomes once a person has been severely injured.

The association of increased population-based crash mortality with rural location is well-established (Baker et al., 1987; Kmet & Macarthur, 2006; Melton et al., 2003; Peek-Asa, Britton, Young, Pawlovich, & Falb, 2010; Rutledge et al., 1993), and a significant part of the increased risk appears to be related to mortality given that injury has occurred (Clark, 2003; Goldstein et al., 2011). However, the degree to which the outcome is determined by geographic limitations to EMS (whether or not they might be correctable) has been more difficult to define.

Brodsky (1993) and Mueller, Rivara, and Bergman (1988) cited evidence that delays in EMS and hospital care contributed to the increased traffic mortality in rural areas, but acknowledged that other factors might be present. Maio, Green, Becker, Burney, and Compton (1992) and Chen, Maio, Green, and Burney (1995) found evidence that the increased rural mortality might be due to older age, more use of alcohol, higher speeds, or other pre-crash factors, but no evidence that the quality of medical care in rural areas is inferior to that in urban areas. Muelleman, Wadman, Tran, Ullrich, and Anderson (2007) found that the rural risk in Nebraska was higher even after controlling for injury severity, but Gedeborg et al.(2010) found no increased rural risk in Sweden after controlling for injury severity.

The results in this paper confirm the disparity in crash outcomes between rural and urban locations (Clark, 2003; Clark & Cushing, 1999, 2004; Goldstein et al., 2011), and show that the increased odds of death or severe injury persists after controlling for acknowledged pre-crash risk factors. The inability to identify any effect of other specific medical resource deficiencies may be due to the relatively small number of rural counties contained in the NASS-GES sample.

This study also confirms the findings of Goldstein et al. (2011) that severe injuries are more likely in southern states versus northern states, but that mortality is not significantly different once a severe injury has occurred. This does not suggest any deficiency in southern EMS systems, but raises questions about why serious injuries are more frequent. The increased southern mortality (Model 1 and 2) from crashes has been previously noted (Clark & Cushing, 1999, 2004; Washington et al., 1999), but is still not completely explained.

While there was a lower probability of severe injury in males compared to females, there was a higher probability of death for males given that severe injury had occurred. It is difficult to determine whether this represents actual biological factors (e.g., larger size, stronger bones, comorbidities) or whether it simply represents a difference in defining "incapacitated" on the part of the police or the involved person. There has been an ongoing debate about whether female sex is protective for patients hospitalized with injuries (Clark & Winchell, 2004; Croce, Fabian, Malhotra, Bee, & Miller, 2002; George, McGwin, Metzger, Chaudry, & Rue, 2003), even to the point of recommending female hormones for some injured male patients (Wright et al., 2007).

## Limitations

Although NASS-GES is a representative sample of U.S. police reported crashes it has some limitations that should be addressed. Certain variables were not available including precise location of the crash, EMS scene and transport times, place and time of death, and injury severity scores beyond police reported outcomes. The NASS Crashworthiness Data System (NASS-CDS) contains some of these variables, including medically assigned injury scores. However, NASS-CDS has fewer sampling locations and contains very little data from rural areas.

While NASS-GES also has a relatively small number of rural sampling sites, it does contain a large number of rural crashes. Previous studies have shown that if the driver's county of residence is rural, this is a good predictor that the county of a crash is at least as rural (Blatt & Furman, 1998). However, Kweon and Lee (2010) emphasize that NASS-GES may not be as useful for narrowly focused studies such as bicycle safety. FARS might be a useful database to explore a greater diversity of rural counties, but it includes only crashes involving a fatality. Elliott and colleagues (2006) have suggested combining FARS with NASS-CDS, and FARS could similarly be combined with NASS-GES, but this still would not increase the denominator of nonfatal crashes to allow for further regional comparisons.

Other investigators have compared multiple injury levels instead of only binary outcomes as in this paper Moore, Schneider, Savolainen, and Farzaneh (2011) used multinomial models to study four levels of injury severity (possible, minor, severe and property damage only) in Ohio crash reports involving bicyclists. Zhu and Srinivasan (2011) have reviewed a number of other approaches to modeling more than one level of severity. The main interest of the current study was related to mortality and EMS system challenges. Focusing only on the most severe injuries was therefore appropriate, although more detailed severity scores would have been useful. Without such a score, vehicle damage and other proxies was used to help control for injury severity.

### Conclusions

In conclusion, a multi-year sample of crash data shows that severely injured motorists in rural counties were almost twice as likely to die as those in urban counties, and that this disparity could not be attributed to other person-level or event-level differences. Additional data containing precise distances or EMS response times might help explain the reasons for increased mortality in rural areas, and whether any of the responsible factors might be modifiable to reduce this disparity. Databases with a larger selection of rural injury crashes might help differentiate the importance of specific medical resources.

The principal finding of this study was that motorists severely injured in rural crashes have a higher probability of death, even after controlling for individual or other event risk factors. Person-level risk factors associated with an overall increased mortality included increased age, males, not wearing a safety belt, and ejection from the vehicle. Event-level risk factors associated with mortality included vehicle speed (> 50mph), moderate or severe vehicle damage, and crashes from midnight to 6 a.m.

### Impact on Industry

Although traffic mortality may be most effectively reduced by injury prevention, the additional benefit from improvements in emergency communication, transportation, and medical care for injured persons in rural areas may justify additional investment.

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## Biography

“Association of rural location with mortality after severe injury from motor vehicle crashes”

Lori L. Travis has been conducting statistical data analyses at the Center for Outcomes Research and Evaluation at the Maine Medical Center for the past five years. She received a Master's Degree in Statistics from the University of Southern Maine in 2001, and since then has taken post-graduate courses in Public Health and Biostatistics at the George Washington University and the University of Pittsburgh. She has worked with a variety of health-related databases including national clinical studies on Type II diabetes, CMS Medicare, administrative hospital files, and other injury files including FARS and NASS-CDS.

David E. Clark is a graduate of the George Washington University Medical School. He also received a Master's Degree in Statistics from the University of Southern Maine and a Master's Degree in Public Health from Harvard University. He is currently Attending Surgeon in the Division of Trauma and Critical Care at Maine Medical Center, and Professor of Surgery at Tufts University Medical School. He is a Fellow of the American College of Surgeons and has been a member of its Committee on Trauma. He is author or coauthor of numerous publications in the fields of injury epidemiology and trauma systems evaluation.

Amy E. Haskins obtained a Ph.D. in Epidemiology from the University of Massachusetts-Amherst and is currently a Scientist at the Center for Outcomes Research and Evaluation at Maine Medical Center. Her dissertation research focused on smoking during pregnancy among Hispanic women and risk of negative pregnancy outcomes. Currently, she is using a clinical database to examine quality of life outcomes after prostate cancer treatment. She is

lead author on a study to be published later this year, which uses data from NASS-CDS to examine racial variation in traffic crash mortality.

Joseph A. Kilch was a Research Assistant at the Center for Outcomes Research and Evaluation at Maine Medical Center when this work was carried out. He is currently a student at the University of Vermont College of Medicine.

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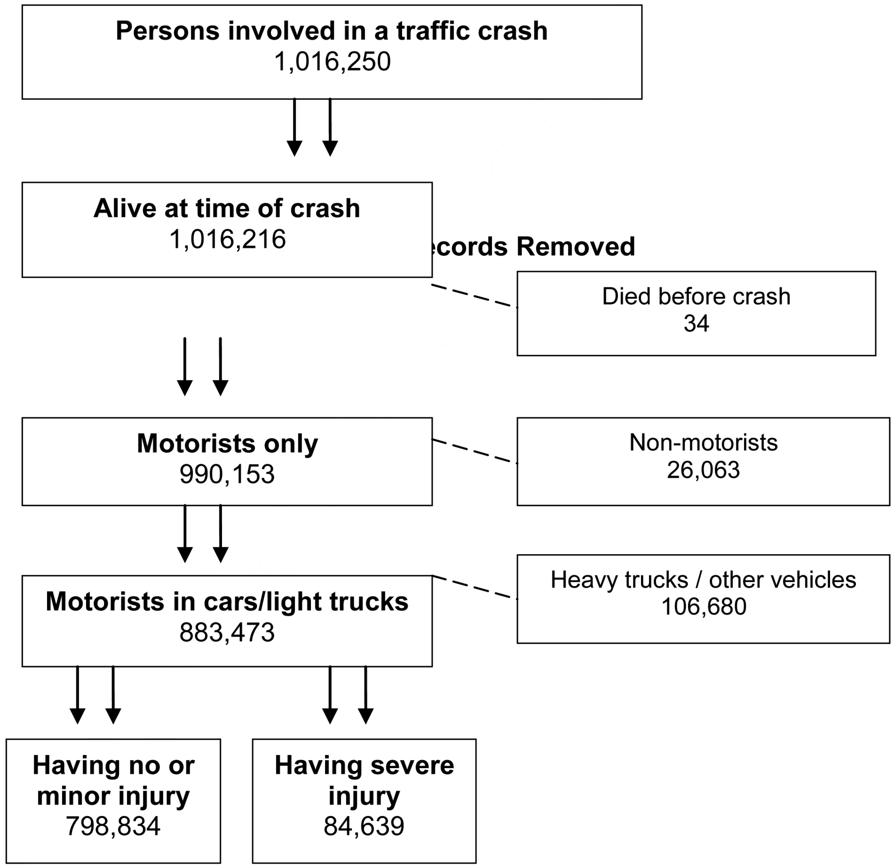


**Figure 1.**
NASS-GES 2002-2008 sample inclusion criteria for the study

## Table 1

Rural-Urban Continuum Codes (RUCC) for NASS-GES and US Counties

| RUCC | Definition | NASS-GES / US Counties n= 77 / N= 3142 | NASS-GES Sample Crashes n= 401,983 | NASS-GES Weighted Crashes N= 42,680,732 |
|---|---|---|---|---|
| 1 | Counties in metro areas of 1 million population or more | 39 / 414 | 229,074 | 20,712,622 |
| 2 | Counties in metro areas of 250,000 to 1 million population | 14 / 325 | 84,995 | 9,161,404 |
| 3 | Counties in metro areas of fewer than 250,000 population | 7 / 351 | 57,404 | 8,049,412 |
| 4 | Urban population of 20,000 or more, adjacent to a metro area | 6 / 218 | 22,731 | 3,228,408 |
| 5 | Urban population of 20,000 or more, not adjacent to a metro area | 0 / 105 | 0 | 0 |
| 6 | Urban population of 2,500 to 19,999, adjacent to a metro area | 3 / 609 | 2,107 | 338,113 |
| 7 | Urban population of 2,500 to 19,999, not adjacent to a metro area | 5 / 450 | 2,744 | 588,630 |
| 8 | Completely rural or less than 2,500 urban population, adjacent to a metro area | 2 / 235 | 516 | 66,004 |
| 9 | Completely rural or less than 2,500 urban population, not adjacent to a metro area | 1 / 435 | 2,412 | 536,139 |

*Source: http://www.ers.usda.gov/Briefing/Rurality/RuralUrbCon/

## Table 2

NASS-GES weighted characteristics across injury levels

| Characteristics** 2002-2008 | No Injuries | Minor* Injuries | Incapacitating Injuries | Fatal Injuries | Wald-Chi.square p-value |
|---|---|---|---|---|---|
| **Sample (n)** | 576,895 | 221,939 | 77,031 | 7,608 | |
| **Weighted (N)** | 81,313,741 | 15,196,193 | 1,748,289 | 153,769 | |
| **Motorist (%)** | | | | | |
| Ages | | | | | |
| 0-14 | 10.20 | 7.99 | 6.39 | 3.96 | |
| 15-39 | 54.40 | 55.17 | 57.10 | 50.28 | |
| 40-64 | 28.43 | 29.17 | 27.22 | 30.24 | |
| 65-79 | 5.50 | 5.89 | 6.43 | 10.83 | |
| 80+ | 1.48 | 1.78 | 2.32 | 4.68 | <0.001 |
| Male | 55.69 | 44.54 | 48.92 | 66.38 | <0.001 |
| Unbelted | 13.17 | 14.41 | 25.81 | 61.56 | <0.001 |
| Seated in front | 88.67 | 89.64 | 89.85 | 90.35 | 0.679 |
| Ejected from vehicle | 0.01 | 0 32 | 3.96 | 25.87 | <0.001 |
| Taken to the hospital | 0.18 | 51.20 | 95.79 | 42.48 | <0.001 |
| **Vehicle (%)** | | | | | |
| Rolled over | 1.35 | 7.94 | 18.67 | 35.48 | <0.001 |
| High speed | 20.33 | 24.61 | 41.36 | 67.34 | <0.001 |
| Damaged | 31.29 | 62.47 | 83.83 | 91.29 | <0.001 |
| Towed | 25.05 | 65.77 | 90.68 | 95.36 | <0.001 |
| Occupants ≥2 | 45.21 | 50.10 | 50.10 | 46.05 | <0.001 |
| Alcohol involved | 3.34 | 5.14 | 12.02 | 20.51 | <0.001 |
| **Crash (%)** | | | | | |
| Midnight to 6AM | 5.43 | 7.75 | 12.42 | 21.97 | <0.001 |
| MV Collision | 83.62 | 79.75 | 63.65 | 46.12 | <0.001 |
| Adverse weather | 21.88 | 21.14 | 19.30 | 21.72 | 0.038 |
| Interstate Highway | 7.54 | 7.34 | 11.20 | 13.72 | 0.155 |
| **Location (%)** | | | | | |

| Characteristics** 2002-2008 | No Injuries | Minor* Injuries | Incapacitating Injuries | Fatal Injuries | Wald-Chi.square p-value |
|---|---|---|---|---|---|
| Southern State | 44.44 | 45.79 | 65.68 | 57.53 | 0.038 |
| RUCC codes | | | | | |
| 1-3 (non-rural) | 90.42 | 86.92 | 87.55 | 73.96 | |
| 4-5 (partly rural) | 6.65 | 8.20 | 7.57 | 13.02 | |
| 6-7 (rural) | 1.83 | 2.85 | 2.64 | 6.82 | |
| 8-9 (very rural) | 1.11 | 2.02 | 2.24 | 6.20 | 0.306 |
| ACS Trauma Ctr. ≥1 | 25.83 | 26.72 | 12.65 | 13.97 | 0.002 |
| Neurosurgeons ≥10 | 41.62 | 45.66 | 25.67 | 22.96 | <0.001 |
| Operating Rooms ≥50 | 43.31 | 46.56 | 22.80 | 23.93 | <0.001 |
| EMTs ≥ 200 | 45.52 | 50.13 | 23.06 | 23.41 | <0.001 |

* Minor injuries include police-reported categories of “possible”, “non-incapacitating”, or “severity unknown”

** Percentages are based on the weighted totals

## Table 3

NASS-GES weighted survey logistic model odds ratios for injury outcomes

| Covariates* OR (95% CI)** | Model 1 Crash Outcome: Odds of death, overall | Model 2 Crash Outcome: Odds of severe injury, overall | Model 3 Crash Outcome: Odds of death, if severely injured |
|---|---|---|---|
| **Sample (n)** | 883,473 | 883,473 | 84,639 |
| **Weighted (N)** | 98,411,993 | 98,411,993 | 1,902,059 |
| Baseline Odds | 0.0000268 | 0.00216 | 0.0111 |
| Age | | | |
| 0-14 | 0.67 (0.51 - 0.87) | 0.77 (0.64 - 0.92) | 0.89 (0.70 - 1.11) |
| 15-39 | referent | referent | referent |
| 40-64 | 1.96 (1.73 - 2.22) | 1.22 (1.15 - 1.30) | 1.74 (1.52 - 2.00) |
| 65-79 | 4.66 (3.88 - 5.60) | 1.63 (1.39 - 1.90) | 3.48 (2.89 - 4.19) |
| ≥80 | 8.05 (6.60 - 9.82) | 2.19 (1.78 - 2.71) | 4.72 (3.83 - 5.82) |
| Male | 1.15 (1.06 - 1.25) | 0.72 (0.66 - 0.78) | 1.50 (1.38 - 1.62) |
| Unbelted | 9.36 (8.10 - 10.82) | 2.95 (2.46 - 3.55) | 3.88 (3.06 - 4.92) |
| Front seat position | 1.11 (0.90 - 1.38) | 1.12 (1.03 - 1.22) | 1.12 (0.97 - 1.30) |
| | 4.01 (3.41 - 4.72) | 3.53 (3.22 - 3.88) | 1.56 (1.37 - 1.77) |
| Vehicle rollover | | | |
| High speed | 3.70 (3.21 - 4.27) | 1.87 (1.67 - 2.10) | 2.09 (1.82 - 2.41) |
| Vehicle damage | 10.36 (8.08 - 13.27) | 7.15 (5.21 - 9.82) | 1.37 (1.09 - 1.71) |
| Midnight to 6AM | 1.60 (1.42 - 1.80) | 1.29 (1.13 - 1.47) | 1.43 (1.29 - 1.59) |
| Southern State | 1.79 (1.42 - 2.24) | 2.30 (1.26 - 4.19) | 0.82 (0.56 - 1.19) |
| RUCC Codes | | | |
| 1-3 urban | referent | referent | referent |
| 4-5 partly rural | 1.18 (0.92 - 1.50) | 0.74 (0.38 - 1.43) | 1.49 (0.90 - 2.48) |
| 6-7 rural | 1.24 (0.59 - 2.63) | 0.78 (0.47 - 1.29) | 1.82 (1.01 - 3.29) |
| 8-9 very rural | 2.31 (1.68 - 3.18) | 1.41 (1.05 - 1.91) | 1.93 (1.64 - 2.27) |

*Survey Design – weight (NASS-GES inverse selection probability), 14 strata (PSU strata), and 77 clusters (counties)

**OR = Odds Ratio, CI = Confidence Interval, based on weighted totals